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ABSTRACT

This project was a partial evaluation of the new approach to teaching medical microscopic anatomy developed at the University of Iowa. The format of the course included specific objectives given to the students in advance, with the main sources of information coming from independent readings and laboratory exercises, demonstration of mastery of the units by passing combined written and oral examinations before moving on to the next unit, individualized pacing of course work, and weekly student seminars on topics from this course and others running concurrently. The overall effectiveness of the format compared to that of other courses was considered by the students responding to a questionnaire to be very high. It was found that comprehensive examinations and unit quizzes significantly increased achievement, even though the students rated them less desirable than other characteristics of the course. The seminars required more of the students' time for preparation than was justified by the benefits and therefore were discontinued. (CP)

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FINAL REPORT
Project No. 0-F-002
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THE EVALUATION OF A NEW APPROACH TO TEACHING MICROSCOPIC ANATOMY

James R. Scranton
The University of Iowa
Iowa City, Iowa 52240

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The research reported herein was performed pursuant to a grant with the Office of Education, U. S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

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SUMMARY

This project was a partial evaluation of the new approach to teaching medical microscopic anatomy developed at the University of Iowa. The new approach differed most motably from the traditional one in the following respects:

1. Written specific objectives for each segment of the course work were given to the students.
2. Readings and laboratory exercises that could be done by the students independently, rather than lectures, served as the main sources of information for the students.
3. Each student was required to demonstrate his mastery of each of the nine or ten units of course work by passing a combined written and oral examination before moving on to the next unit.
4. Each student was permitted to proceed through the course work at his own pace.
5. Student seminars on topics from this course and the others running concurrently were held weekly.

Student opinion of the overall effectiveness of the course format and of the value of each specific feature of the course was collected by questionnaire. Items 1. through 4. above were rated very highly by the students, whereas the seminars, the midterm and final examinations, and the lectures were rated much lower. The overall effectiveness of the course format relative to that of other formats to which they had been exposed was considered by the students to be very high.

In one class the students were divided into two equal groups which were treated identically except that one group took a midterm and a final examination, in addition to the unit quizzes, whereas the other group took only the unit quizzes. Eight months after they had finished the course both groups took an unannounced examination. Analysis of the performances of the two groups on this examination indicated that the group which had taken the comprehensive examinations scored significantly higher ($P<0.02$). The mean scores (number correct out of 50) and the standard errors of the means were 35.4 ± 0.61 versus 32.9 ± 0.77. There was no significant difference between the groups at the start of the course, as judged by their grade point averages on all science courses taken previously.

Each of the students in the succeeding class took unit quizzes only on alternate units of course work and was told to determine for himself when he had met the objectives of the other units. All took a final examination ½ of which consisted of questions from the material over when any particular student was quizzed, the other ½ being from the material over which that student was not quizzed. Comparison of the scores on the two halves of the examination showed a significant improvement in performance attributable to the unit quizzes ($P<0.05$). The mean scores (number correct out of 33)and the standard error of the means for the questions from the material over which they had been quizzed and the material over when they had not, respectively, were 25.6 ± 0.23 and 24.8 ± 0.26.

The following conclusions were drawn:

1. Overall the new approach was effective as judged by student opinion.
2. The seminars required more of the students' time for preparation than was justified by their benefit and therefore they were dropped.
3. Comprehensive examinations, even when frequent short quizzes are given, significantly affect learning and therefore should be retained.
4. The short unit quizzes, in the context of this course format, significantly affect learning and should therefore be retained.

INTRODUCTION

As part of an overall revision of the College of Medicine curriculum at The University of Iowa the microscopic anatomy course was extensively reorganized in 1968. Thorough consideration was first given to the teaching methods traditionally used for the course, in terms of their probable roles in student learning. It was concluded that this teaching approach, while reasonably efficient considering the instructor's time and effort, might be rather inefficient when considered from the learner's point of view. Consequently, many features of the traditional approach were deliberately avoided when the new strategy was devised. The new approach, based in part on the published experiences of others, was intended to better conform to the needs of the students and thereby facilitate their learning.

The new approach was first tried in the fall of 1968 and was generally considered by students and faculty, as judged by opinion questionnaire, to be successful. The evidence for its effectiveness was, however, entirely subjective. In 1969 and 1970 experiments were conducted to collect information from which an objective evaluation could be made. These experiments plus the results of opinion questionnaire are the subject of this report.

The traditional approach and the new one are described briefly and compared in the next few paragraphs. The initial plan to compare the results of two approaches on the basis of student performance on the National Boards Examination could not be carried out. The following description and comparison of the two methods will, none the less, serve to orient the reader to the new approach and emphasize its unusual features.

The Traditional Approach

As microscopic anatomy was traditionally taught in this medical school and many others, the lecture and the textbook were the major sources of information for the students. Laboratories provided practical experience in the use of the microscope and discussion sessions allowed the students to ask questions, which were usually on points they found confusing in the lectures or readings. The lectures, laboratories and discussions were tightly scheduled and, consequently, most students attended them according to the prescribed schedule in order to keep up and avoid missing out on anything. One to one conversation between a student and an instructor could occur in the laboratory or outside the classroom. In either case it was initiated by the student, the result being that many of the less aggressive or less self-confident students rarely talked to an instructor.

Separate written and practical examinations were given four times during the semester. These served to let the students know what was expected of them, i.e.,to define the course objectives, as well as for the evaluation of student performance. The written examinations were primarily or entirely over facts and concepts presented in lectures, while the practical examinations tested the students' ability to identify, with the aid of their microscopes, specimens they had previously studied in

the laboratory. As a result of this dissociation of lecture material and laboratory skills, the students tended to regard these two aspects of the course as separate entities.

The New Approach

Several of the concepts and techniques employed in the experimental approach are based on the published experiences of others in teaching other courses. The overall format is similar to that described by Keller (1968) for teaching elementary psychology. The use of rear-screne projectors in the teaching laboratory to supplement the microscope was described by Stinson and Smith (1968). The importance of clearly defining course objectives has been emphasized by Bloom, et al. (1956), Mager (1962), Mosel (1964), Miller (1966), Payne (1968) and many others.

The material to be covered in the course has been divided into ten units, each of which is to be mastered by every student before he moves on to the next. When he is ready to start work on a unit, the student is given a set of directions. In addition to reading and laboratory assignments, the directions include a statement of specific objectives, which tells him what he is expected to do to demonstrate his mastery of the unit. It is emphasized that these objectives represent the minimum that is required of every student not a maximum.

Among the laboratory exercises for all units are sets of 2x2 slides of light and electron micrographs with accompanying written comments and questions. These are studied by students individually or in small groups using rear-screen projectors. The slide programs, developed by the course instructors, are designed to introduce the students to microscopic features they will subsequently study with their own microscopes and to expose them to special preparations they would not otherwise see. This type of exercise focuses the student's attention on a micrograph as a source of information rather than on the written word in a textbook or the spoken word in a lecture. Having been introduced to the topic of a particular unit in this way, the students consider the subject further by studying specimens under their microscopes and by reading about it. The laboratory is used as a study room, where all the learning devices to be used in meeting the unit objectives are available, not just a place to develop the practical skills of microscopy. Specific laboratory exercises are not assigned at particular times and attendance in the laboratory is not noted.

When a student thinks he is thoroughly prepared on a particular unit, he so indicates and is given a written quiz designed to test for a) recall of facts and the meanings of terms, b) understanding of concepts and principles and c) ability to combine facts, ideas and procedures to solve problems. He takes the completed written quiz to a proctor (a faculty member or graduate student teaching assistant) who immediately grades the paper and discusses it with the student. During this discussion the proctor further examines the student orally on a) the practical aspects of the unit, using a dual viewing microscope and

b) his ability to use correctly the vocabulary of the subject. The contents of the quizzes are precisely as indicated in the statements of objectives. If the student passes he is given the directions for the next unit and is allowed to proceed. If he fails, he is told to continue working on the same unit and to return to be reexamined when he is ready. The pace at which a student moves through the course is up to him.

Lectures have a different relationship to the rest of the course than is usually the case. They are less frequent, one per week, and the topics are scheduled at times when it is expected that most students will have finished the unit covering the basic information on the subject. The lecturer, under these circumstances, can elaborate on particularly interesting or difficult aspects of the subject with confidence that his audience is well grounded on the fundamentals. These lectures, for which attendance is voluntary, are intended to stimulate interest rather than convey basic information. Consequently, clinical applications of knowledge of microscopic anatomy are frequently chosen as lecture topics to take advantage of the particular interests of medical students.

Weekly student seminars on topics from gross anatomy, embryology and biochemistry, as well as microscopic anatomy, give the students experience in preparation and presentation of short talks and help to integrate the material covered in the various courses. The ten minute presentations are followed by discussions involving both students and faculty. Each student presents four seminars during the semester.

The experimental approach differs most notably from the traditional in the following respects.

1. Specific objectives are clearly defined in terms of the behavior expected of the student. He can, therefore, use the statements of objectives as a guide while he is studying rather than waiting for a major examination from which to judge what he should have studied.

2. Laboratory exercises rather than lectures are emphasized as the main sources of the basic information. Through the use of rear-screen projectors and programmed slides, the students' attention is focused on pictures of, rather than verbal descriptions of, the structures to be studied.

3. Lectures serve primarily as vehicles of motivation rather than sources of information. Knowing this the students are able to listen to the lectures, taking few or no notes. This is in marked contrast to the situation, under the traditional approach where students, relying on the lectures for information, try to write down everything the lecturer says and, consequently function as stenographers rather than learners during class time. They then study their notes, which are frequently inaccurate, at home in the evening.

4. The student seminars provide experience in the preparation and delivery of oral reports. The development of the ability to use the vocabulary of the biological sciences and the understanding of the relationships between the various disciplines are facilitated by these presentations.

5. The requirement that every student demonstrate his mastery of each unit, by passing the unit quiz, before moving on prevents the students from skipping or putting off until later, e.g., just before a major examination, any of the material. It also makes it a certainty that every student will be involved in discussion on a one to one basis with an instructor at least ten times during the semester and, furthermore, that the weakest students will spend the most time in these discussions, since they must repeat the quiz every time they fail one.

6. The form of the unit quiz, written and practical parts that are promptly graded and discussed, provides immediate feedback and almost unavoidable tutoring so that the quizzes are truly learning experiences. In addition, the unified written and practical quiz helps avoid one of the undesirable features of the traditional approach, namely, the tendency of the students to regard the lecture and the laboratory aspects of the course as separate entities. This attitude is perpetuated, in the traditional approach, by the separate examinations on the lecture material and the laboratory skills.

7. The "go-at-your-own-pace" feature permits a student to move through the course at a speed commensurate with his ability and other demands on his time rather than by a prescribed schedule.

METHODS

The project was carried out during two academic years, 1969-1970 and 1970-1971. Two classes of first semester freshman medical students at the University of Iowa were the subjects. Each year the microscopic anatomy course was conducted as described in the preceeding section with minor modifications which will be described. The classes will be referred to in this report as the "1969 class" and the "1970 class".

The 1969 Class

The class of 130 students was divided randomly into two equal groups, hereafter referred to as "Section A" and "Section B". The mean grade point average on all science courses taken previously was computed for each group. The two sections were treated exactly the same, as described in the introduction, except that Section A took two additional examinations--one near the middle of the semester and one at the end. The midterm examination covered the material in the first five units and the final examination covered the entire course. Both consisted of written and practical portions--the written part requiring short answers not exceeding a few sentences and the practical part requiring identification of specimens under the microscope. The course was completed on January 28, 1970,

all students passing. On September 30, 1970, one year after they had started the microscopic anatomy course, these students were given an unannounced 50 item multiple-choice examination over microscopic anatomy. This examination was analyzed in terms of its reliability, difficulty and discrimination. Mean scores were computed for Sections A and B and they were tested for significance of their difference using Students "t" test. The entire class was divided into upper, middle and lower 1/3's on the basis of the scores on this examination and the number of students from each Section (A and B) in each 1/3 determined.

At the beginning of the course and again at the end all students answered a questionnaire that contained these questions:

> "Based on your experiences in all courses, are examinations over large segments of course work, such as midterm and final examinations, useful as learning experiences?"
>
> "If other methods of conveying to the students what the instructor considers "important" (the objectives) and of evaluating student performance were available, should such examinations be eliminated?"

In addition an eleven page questionnaire was given to each member of the class just before the end of the semester (see appendix A) and they were asked to fill it out and return it. Eighty were returned from the class of 130. This questionnaire sought student opinion on all aspects of the course.

The 1970 Class

The course offered to the 1970 class differed slightly from the one described in the introduction. The modifications were:

1. There were no student seminars.

2. The subject matter was divided into nine rather than ten units.

3. Each student took quizzes on five of the nine units--Section C (half of the class divided alphabetically) on units I, III, V, VII and IX and Section D (the other half of the class) on units I, II, IV, VI and VIII. On the four units over which a student was not quizzed he was told "It will be up to you to determine when you have met the objectives".

4. Both sections took a final examination consisting of 66 multiple-choice items 33 of which were based on the material from units III, V, VII and IX, the other 33 being based on the material from units II, IV, VI and VIII.

The final examination was graded in two parts--the 33 questions from the material over which the students in Section C took quizzes and the 33 questions from the material over which the students in Section D took quizzes. Thus for each student there was a score for the material

over which he had been previously quizzed and one for the material over which he had not been quizzed. The means were determined for these two categories and the significance of difference between them tested by Students "t" test.

On the first page of the final examination each student was asked to respond to the following:

> "I think I am better prepared to be examined on the material covered:
>
> ____ a. in the units for which I took quizzes.
>
> ____ b. in the units for which I did not take quizzes.
>
> ____ c. no difference."

RESULTS

The 1969 Class

The random division of the class into two equal groups was done by the director of the gross anatomy course which ran concurrently with the microscopic anatomy course being evaluated. For comparison of the two groups at the beginning of the experiment the grade point averages on all science courses taken previously were calculated. The means and standard errors of the means obtained were:

Section A	3.404 ± 0.046 and
Section B	3.435 ± 0.055.

There was clearly no significant difference between the groups, as judged by this index of ability, at that time. Students "t" test for significance of difference between means of unpaired variates indicated that P (the probability the difference occuring by chance if the two populations were actually not different) was between 0.6 and 0.7.

The performances of the two groups on the 50 item multiple-choice examination taken one year later (eight months after they had finished the microscopic anatomy course), however, were significantly different. The scores (number correct) on this examination were:

	Mean $\pm$ Standard Error of the Mean
Section A	35.4 ± 0.61 and
Section B	32.9 ± 0.77.

Students "t" test indicated that P was less than 0.02. The course taken by Section A differed from that taken by Section B only in that Section A took midterm and final examinations whereas Section B did not. Division of the whole class into upper, middle and lower 1/3's,

based on the performance on this examination, and determination of the number of students from each section in each 1/3 gave the results shown in TABLE I. Note particularly the wide difference in distribution between the two groups in the lower 1/3.

TABLE I

The number of students ranking in each 1/3 of the class from Section A (took midterm and final examinations) and Section B (no midterm and final examinations).

	NUMBER OF STUDENTS	
	Section A	Section B
Upper 1/3	22	15
Middle 1/3	23	17
Lower 1/3	9	25

The test statistics obtained on the multiple-choice examination and the falues recommended by the Department of Evaluation and Examination Services at the University of Iowa are given in TABLE II. The reliability was estimated by the Kuder-Richardson formula 20. The difficulty index is the number of students getting an item correct divided by the number taking the test and the discrimination index is the difference between the proportion of students in the highest 27% (total test scores) and the lowest 27% choosing the correct response.

TABLE II

Test statistics of the final multiple-choice examination taken by the 1969 class.

TEST STATISTIC	OBTAINED	RECOMMENDED
Mean	34.12	31.25
Standard Deviation	5.34	6.25
Reliability Coefficient ALPHA/KR20	0.72	0.70+
Mean Difficulty	0.68	0.63
Mean Discrimination	0.26	0.31+

Student opinion of the value of midterm and final examinations was polled at the beginning of the course and again at the end. The questions asked were:

1. Based on your experiences in all courses, are examinations over large segments of course work, such as midterm and final examinations, useful as learning experiences?

2. If other methods of conveying to the students what the instructor considers "important" (the objectives) and of evaluating student performance were available, should such examinations be eliminated?

Before they had taken the course 77% of the class answered yes to question 1, whereas at the end of the semester the percentage of affirmative responses dropped to 69 (70% in Section A and 67% in Section B). A large majority of the class also answered yes to question 2 (70% at the start of the semester and 82% at the end). Again with this question there was no difference between Sections A and B, 82% of each answering yes.

The eleven page questionnaire filled out by 80 of the 130 students in the 1969 class is contained in Appendix A. Some of the questions were designed to get student opinion about specific lectures, instructors and objectives while others dealt with the course format. Only the latter will be discussed here. The numbers written into the questionnaire shown in Appendix A are the percentages of respondents choosing the particular responses.

A rating of each of the features of the course in terms of its importance to the overall effectiveness of the course was called for on page eleven. The distributions of responses to these questions are shown in bar graph form in Figures 1. and 2. It is clear from the responses to the last question (Figure 2) that the overall effectiveness of the course format was considered to be very high. Two of the features of the course--the seminars, which were an attempt to coordinate this course with the two others running concurrently, and the midterm and final examinations--received very low ratings (see graphs (7) and (9), Figure 2.). These results and informal feedback from students and instructors indicated that the seminars took far more of the students' time than could be justified by their benefit. Furthermore, the desired integration of course content among the three subjects represented was not achieved. The low rating of the midterm and final examinations will be discussed along with other information about them in the next section of the report.

Of the quizzes, the oral form was considered to be more effective than the written (graphs (4) and (5), Figure 1.). The responses to question 1 on page 6 of the questionnaire indicated that many of the students found the oral quizzes quite stressful. The medium ratings on questions 2 and 3 of page 6 indicate the need for revision of both written and oral quizzes to better allow the students to communicate their knowledge and to better tap their knowledge of the subject.

From the very high rating of the specific objectives on page 11 (graph 1, Figure 1.) it is clear that the students considered them to be useful. The section of the questionnaire on page 3 contains some further information on this subject. Most of the students found the objectives to be clearly stated, about right in specificity and a time saver compared with the usual situation of having no formally stated objectives. The majority of the students (64%) said they usually learned more than the stated minimum while a small minority

Rate the importance to the overall effectiveness of future courses of each of the following:

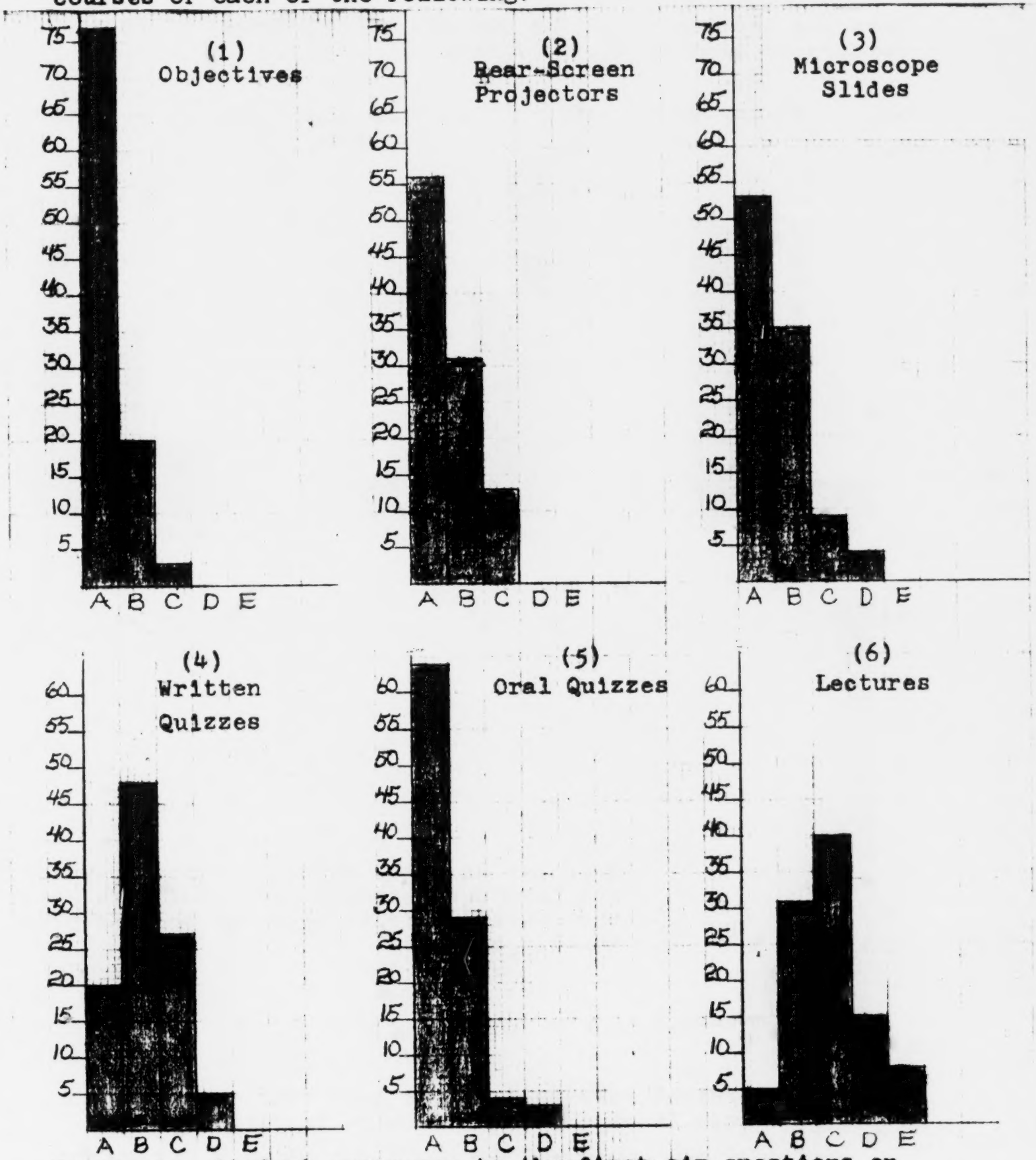
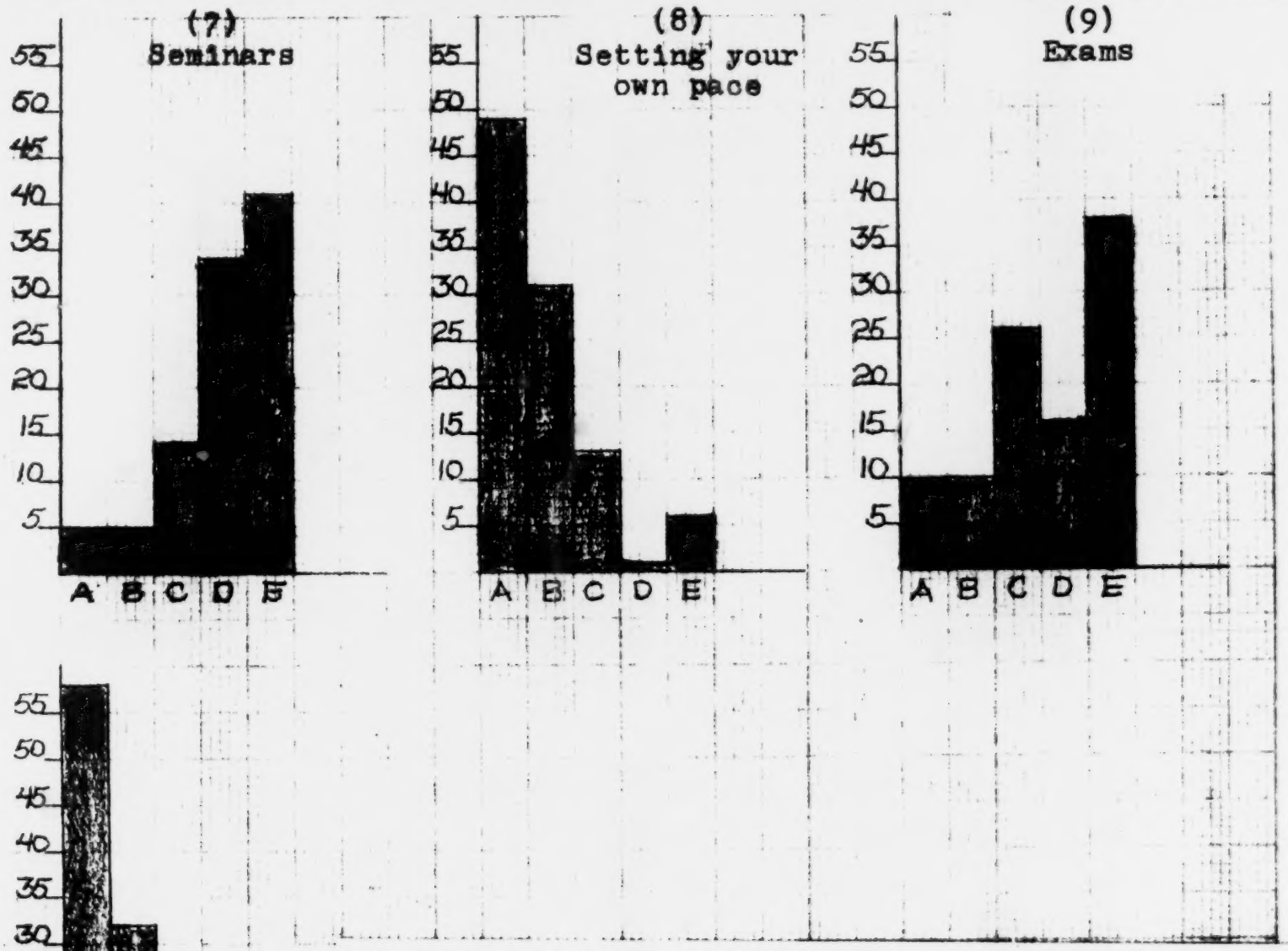
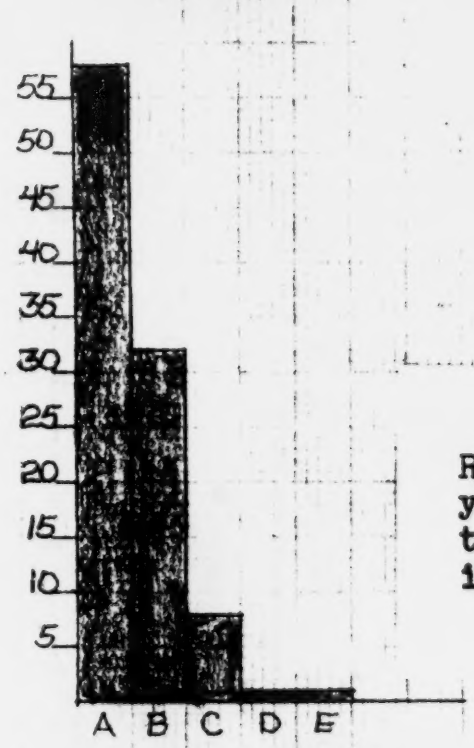


Figure 1. Student responses to the first six questions on page 11 of the questionnaire in Appendix A.

Rate the importance to the overall effectiveness of future courses of each of the following:





Relative to other course formats to which you have been exposed, how would you rate the overall effectiveness of the one used in this course?

Figure 2. Student responses to the last four questions on page 11 of the questionnaire in Appendix A.

(6%) said they usually learned less. The somewhat lower ratings on questions 1 and 4 of page 3 than on the other questions suggest that an effort should be made to show the relevance of this course to medicine and to achieve a closer correlation between the objectives and the quizzes.

The responses to questions 2 and 3 on page 11 of the questionnaire (graphs 2 and 3, Figure 1.) indicate that the two main types of laboratory exercises--rear screen projectors with 2x2 slides and microscope slides--used in the course were considered quite effective by the students. Similar responses to questions 1 and 4 on page 4 of the questionnaire show that the main readings--the unit handouts and the textbooks--were considered quite useful. On the other hand, instructors in the laboratory were considered less useful as sources of information (question 5, page 4). It was evident from the comments made that this lower rating of the instructors was due to their lack of availability rather than the quality of what they had to say when they were available.

The ratings on page 11, question 6 (graph 6, Figure 1.) indicate that the students considered the lectures to be less important than most other features of the course. Nevertheless, when asked if a similar lecture series should be included in the following year's course, 81% said yes (see page 10 of the questionnaire). Sixty-four per cent indicated that the lectures served to increase their interest in the subject even though they were considered less important than the written materials and laboratory exercises as sources of information.

One of the most unconventional features of the course, students setting their own paces for covering the material, was rated rather highly by the students (graph 8, Figure 2.). Note that 6% of those responding gave it the lowest rating, however. This is probably related to the fact that a few of them responded to the pressure placed on them by the other two courses running concurrently by letting microscopic anatomy slide until they were far behind the rest of the class. In any case several of the students were very hard pressed to finish the course in the last few days of the semester.

The 1970 Class

The experiment conducted with the 1970 class as subjects was designed to collect objective information concerning the effects of the unit quizzes, if any, on learning. Each student took the final examination consisting of:
a) 33 questions from the material over which he took quizzes, and
b) 33 questions from the material over which he did not take quizzes.
The mean scores (number correct) and standard errors of the means for a) and b) were:

a) 25.6 ± 0.23, and

b) 24.8 ± 0.26.

The number of students participating was 144. Students "t" test for the significance of a difference between two means indicated that the

probability of this difference occurring if there was actually no difference was less than 0.05. Just before they took the final examination, 47% of the students thought they were better prepared to be examined on the material from the units for which they took quizzes and 53% thought there was no difference, according to the questionnaire.

CONCLUSIONS

The original plan to compare the new approach with the traditional, by using an independently prepared examination to evaluate the performance of students trained by both, was not carried out. The question of whether or not the new approach is an improvement in terms of increasing the amount the students learn from the course, therefore remains unanswered. On the other hand, it is obvious from their responses to the questionnaire that the students reacted favorably to most aspects of the new approach. Furthermore, the faculty and graduate student teaching assistants preferred this system to the traditional lecture-laboratory system. The usual opinion of the instructors was that the new approach facilitated communication between themselves and the students.

The specific objectives were regarded by a majority of the students to be a very useful guide to how to best spend their time. Written objectives are probably particularly important in a course with no schedules to direct the student from one bit of subject matter to the next. They are also particularly useful to students in a field, like medicine, where the accumulated body of knowledge is much too large for any individual to master and one must therefore be selective in deciding how to spend his limited amount of time. The time spent by the faculty in deliberating on and writing the objective for this course was considerable. However, in the judgment of the writer, it was time well spent considering their apparent usefulness to the students and, presumably, the students' time saved.

The readings and laboratory exercises used with the new approach were considered by the students to be effective as sources of information. Though it would be tempting to conclude that they were regarded by the students as better than the lecture as sources of information, such a conclusion is not warranted because the course was designed to focus the students' attention primarily on the readings and laboratory, with the lecture serving a supportive role. While the experiences reported here certainly do not invalidate the lecture as an effective didactic tool, they do indicate that a course not centered around the lecture can be successful from the students' point of view. Furthermore, it was the observation of the writer that the particular instructors involved in this project were much more effective as teachers under this new approach than they were previously with the traditional lecture centered approach.

The "go-at-your-own-pace" feature was incorporated into the course for two main reasons:

1. The students starting the course have widely divergent backgrounds in the subject. For some the course was largely review and for others it was all new. Most were somewhere between. Consequently, the best rate at which to cover the material varies greatly.

2. The responsibility for making ones own decisions as to scheduling, given a limited amount of time and an enormous amount of work, was considered to be reasonable simulation of a physician's daily situation. Hence, this might be a valuable learning experience for the freshman medical student.

While the majority of the students reacted very favorably to this feature of the new approach, a few (about 5%) rated it very low. This may be because they allowed themselves to get far behind their classmates, because of the great demands on their time of their other courses, and had to work very hard at the end to complete the course. If this was the case, point 2 above may have been particularly applicable to them. In the judgment of the faculty involved student self-scheduling was successful and should be retained.

The main functions of examinations in most courses are probably these:

1. Communicating to the student what the instructor expects of him. (i.e., the specific objectives)
2. Evaluation of the students' performance.(i.e., providing information to the student and to the instructor on how well the student is meeting the objectives)
3. Evaluation of the course (i.e., providing feedback to the instructor on how well the course is meeting its objectives), and
4. Student learning.

As the microscopic anatomy course here is designed (the new approach) 1. is apparently well taken care of by the written unit objectives, while 2. and 3. are intended to be handled by the unit quizzes. Under these circumstances the question arises, "what useful functions, if any, do midterm and final examinations perform, i.e., are they useful as learning experiences?" The students taking this course in 1969 were asked this question both at the beginning and at the end of the semester. Seventy-seven per cent answered "yes" at the start and 69% at the end. There was no difference in the responses at the end of the semester between the group which had taken the midterm and final examinations in the course and the one which had not. Curiously, 70% of the class said at the start that these examinations should be eliminated if they were not needed to communicate the objectives or evaluate performance. The percentages of both "examined" and "unexamined" groups responding "yes" at the end of the semester rose to 82. While student opinion and its paradoxical nature is of interest in this context, the key information of this point is the objective data. From the experiment conducted with the 1969 class it is clear that some learning can, indeed, be attributed to the midterm and final examinations. To minimize the effects of experience in dealing with examination questions of a particular type, the examination given the whole class after the course was over was multiple-choice in form whereas all examinations and quizzes taken during the course were other forms. Furthermore, it should be noted that the significant effects of the midterm and final examinations occurred even though both groups had a great deal of experience dealing with quizzes on the subject over small segments of material (i.e., nine unit quizzes each consisting of written and oral parts). Apparently the review and related integration of facts and concepts in preparation for the

comprehensive midterm and final examination was responsible for the better retention of information by the "examined"group. On this basis it was decided to retain at least a comprehensive final examination in future courses.

The unit quizzes as conducted in the course consume a great deal of instructor's time. Information on their effectiveness as learning experiences was, therefore, sought on which to base a decision to reduce their frequency or not. Student opinion in the 1969 class was that especially the oral quizzes, the ones that take the most instructors' time, should be retained. Forty-seven per cent of the 1970 class, which had experience in covering the material with and without unit quizzes thought they were better prepared on the units over which they took quizzes. The other 53% thought there was no difference. The objective data are taken to indicate that the experience with quizzes did have a positive influence on final examination performance ($P<0.05$). It is not clear whether or not the oral part of the quiz was a factor since each quiz consisted of written and oral parts. While the value of the unit quizzes as learning experiences is established by these observations, any decision to reduce their frequency or not must take into account other factors such as availability of instructors' time. Under the circumstances prevailing here it has been decided to retain the written quiz for each unit while reducing the frequency of oral quizzes to every other unit.

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APPENDIX A

Questionnaire

This questionnaire was given to the 130 members of the 1969 class near the end of the semester and they were asked to fill it out and return it at their earliest convenience. Eighty were returned. The numbers written in long hand indicate the percentage of respondents choosing the particular response.

D. Scranton

QUESTIONNAIRE
Medical Microscopic Anatomy
60:105

Your answers to these questions and your comments will be taken into account when the future conduct of the course is planned. Be as frank and specific in your comments as you wish.

Many of the questions require a judgement or rating along a 5 point scale. For these questions, indicate your rating by circling the appropriate letter, A through E. A is the highest rating, E the lowest. For all other questions circle the appropriate phrase, number or letter. Use the back of a page for comments if the allotted space is insufficient.

I. GENERAL (COURSE) OBJECTIVES

The following is the statement of general objectives you were given at the beginning of the course. Indicate how well you think each objective was met.

The general objectives of this course are to provide you with the experiences from which you will develop:

1. An understanding of the facts and concepts of microscopic anatomy sufficient to serve as a meaningful background for your subsequent basic science and clinical courses;

41% A 54% B 5% C D E

2. An understanding of the nature of the experimental evidence on which concepts of biology are based;

9% A 30% B 51% C 10% D E

3. The ability to combine facts, ideas and procedures to solve problems;

9% A 40% B 35% C 15% D 4% E

4. The ability to use correctly the vocabulary of the subject;

38% A 51% B 11% C D E

5. Skill in preparing and presenting short talks and in critically evaluating and discussing the material presented by others;

6% A 19% B 36% C 29% D 10% E

6. The ability to properly use the light microscope;

55% A 36% B 8% C 1% D E

Which of these objectives, if any, do you think are worthwhile and appropriate for a medical microscopic anatomy course?

NONE 94% 1 49% 2 64% 3 90% 4 30% 5 91% 6

Which, if any, do you think are worthwhile but <u>not</u> appropriate for a medical microscopic anatomy course?

NONE 0 1 36% 2 23% 3 0 4 46% 5 3% 6

Should a medical microscopic anatomy course have any other general objectives? If so, what objectives?

II. SPECIFIC (UNIT) OBJECTIVES

Rate the unit objectives with regard to each of the following criteria.

1. Relevance to medical training.

34% A 53% B 13% C 1% D E

2. How clearly they were stated.

56% A 34% B 9% C 1% D E

3. Usefulness as a study guide.

72% A 20% B 6% C 1% D E

4. How well they correlated with the quizzes.

49% A 40% B 10% C 1% D E

The statements of specific objectives were:

8% A. too general.
1% B. too specific.
91% C. about right.

Did you usually learn more, less or about the same as was stated in the unit objectives?

64% A. More.
6% B. Less.
30% C. About the same.

Without the unit objectives do you think you would have spent more, less or about the same amount of time to learn the same amount of material?

70% A. More.
14% B. Less.
16% C. About the same.

Comments:

III. LABORATORY

Rate each of the following with regard to their usefulness to you as sources of information.

1. Unit handouts.

50% A 39% B 9% C 3% D E

2. Rear-screen projectors and 2x2 slides.

48% A 39% B 11% C 1% D 1% E

3. Microscope slides.

38% A 38% B 22% C 3% D E

4. Textbook readings.

41% A 35% B 20% C 3% D 1% E

5. Instructors in the laboratory.

5% A 27% B 32% C 27% D 10% E

6. Other students in the laboratory.

6% A 33% B 30% C 19% D 11% E

In terms of their helpfulness in your study in the laboratory, how would you rate each of the course instructors?

1. Dr. Scranton

	NO IMPRESSION	A	B	C	D	E
	41%	29%	21%	6%	1%	1%

2. Dr. Rolston

	NO IMPRESSION	A	B	C	D	E
	16%	14%	29%	26%	7%	6%

3. Dr. Kochhar

	NO IMPRESSION	A	B	C	D	E
	23%	24%	35%	10%	6%	3%

4. Mrs. Paine

	NO IMPRESSION	A	B	C	D	E
	23%	9%	30%	23%	14%	3%

5. Mr. Cress

	NO IMPRESSION	A	B	C	D	E
	41%	10%	26%	16%	5%	2%

6. Mr. Hiza

NO IMPRESSION	A	B	C	D	E
19%	6%	31%	24%	20%	0

7. Mr. Jacobs

NO IMPRESSION	A	B	C	D	E
14%	40%	40%	6%	0	0

8. Mrs. Moriarty

NO IMPRESSION	A	B	C	D	E
33%	20%	34%	13%	1%	0

9. Mr. Sellers

NO IMPRESSION	A	B	C	D	E
25%	8%	46%	15%	6%	1%

Comments:

IV. QUIZZES

Rate the unit quizzes, written and oral parts, with regard to each of the following criteria.

1. Amount of stress (A=least stress, E=most stress).

Written quizzes.

23% A 30% B 37% C 10% D E

Oral quizzes.

10% A 19% B 25% C 25% D 20% E

2. How well you could communicate what you knew.

Written quizzes.

14% A 44% B 36% C 6% D 1% E

Oral quizzes.

17% A 41% B 22% C 19% D 1% E

3. How well they tapped your knowledge of the subject.

Written quizzes.

3% A 30% B 44% C 22% D 3% E

Oral quizzes.

19% A 36% B 23% C 14% D 6% E

Considering the oral quizzes as learning experiences, how would you rate the effectiveness of each of the course instructors with whom you had contact?

1. Dr. Scranton

NO IMPRESSION	A	B	C	D	E
11%	53%	26%	8%	0	1%

2. Dr. Rolston

NO IMPRESSION	A	B	C	D	E
14%	11%	18%	31%	10%	15%

3. Dr. Kochhar

NO IMPRESSION	A	B	C	D	E
36%	16%	25%	11%	4%	5%

4. Mrs. Paine

NO IMPRESSION	A	B	C	D	E
45%	6%	19%	15%	8%	6%

5. Mr. Cress

NO IMPRESSION	A	B	C	D	E
53%	8%	18%	19%	3%	1%

6. Mr. Hiza

NO IMPRESSION	A	B	C	D	E
27%	3%	25%	30%	10%	5%

7. Mr. Jacobs

NO IMPRESSION	A	B	C	D	E
31%	38%	29%	3%	0	0

8. Mrs. Moriarty

NO IMPRESSION	A	B	C	D	E
41%	21%	25%	9%	3%	0

9. Mr. Sellers

NO IMPRESSION	A	B	C	D	E
23%	8%	39%	19%	11%	0

Comments:

V. LECTURES

Rate each of the lectures you attended in terms of relevance of the topic, interest and skill of the presentation.

1. Dr. Caplan — Cutaneous Anatomy--Where Skin Disease Happens.

Didn't Attend. 5%

Relevance A 27% B 38% C 32% D 3% E 0

Interest A 30% B 42% C 23% D 4% E 1%

Presentation A 31% B 49% C 10% D 7% E 3%

2. Dr. Diecke — Some Properties of Excitable Membranes.

Didn't Attend. 23%

Relevance A 11% B 37% C 35% D 15% E 2%

Interest A 15% B 34% C 26% D 17% E 8%

Presentation A 13% B 16% C 48% D 15% E 6%

3. Dr. Halmi — Some Anomalies of Bone Formation and Reconstruction.

Didn't Attend. 33%

Relevance A 15% B 50% C 25% D 10% E 0

Interest A 2% B 38% C 40% D 15% E 6%

Presentation A 4% B 26% C 44% D 23% E 4%

4. Dr. Schottelius — The Molecular Basis of Muscle Contraction.

Didn't Attend. 26%

Relevance A 26% B 57% C 17% D 2% E 0

Interest A 25% B 48% C 23% D 4% E 0

Presentation A 14% B 53% C 27% D 6% E 0

5. Dr. Karlsson — The Three-dimensional Ultrastructure of Neurones.

Didn't Attend. 55%

Relevance A 6% B 17% C 40% D 14% E 23%

Interest A 10% B 33% C 23% D 23% E 10%

Presentation A 3% B 23% C 20% D 37% E 17%

6. Dr. Gillingham — Applied Vestibular Physiology

Didn't Attend. 45%

Relevance
A 32% B 29% C 29% D 7% E 2%

Interest
A 46% B 24% C 22% D 2% E 5%

Presentation
A 54% B 24% C 15% D 5% E 2%

7. Dr. Nuki — Some Research Perspectives and Oral Diseases.

Didn't Attend. 48%

Relevance
A 13% B 28% C 44% D 10% E 5%

Interest
A 18% B 44% C 31% D 3% E 5%

Presentation
A 13% B 47% C 26% D 8% E 5%

8. Dr. Lascari — Molecular Basis of Hematologic Disorder.

Didn't Attend. 43%

Relevance
A 49% B 44% C 7% D 0 E 0

Interest
A 35% B 60% C 5% D 0 E 0

Presentation
A 26% B 58% C 16% D 0 E 0

9. Dr. Kent — Some Aspects of Structure- Function Relationship in the Gastrointestinal Tract.

Didn't Attend. 43%

Relevance
A 37% B 44% C 15% D 2% E 0

Interest
A 14% B 44% C 32% D 7% E 2%

Presentation
A 16% B 42% C 28% D 5% E 9%

10. Dr. Erlandsen — Cellular Responses to Intestinal Microorganisms.

Didn't Attend. 68%

Relevance
A 23% B 28% C 36% D 4% E 0

Interest
A 18% B 45% C 23% D 9% E 5%

Presentation
A 9% B 50% C 32% D 0 E 9%

11. Dr. Metcalf — Spermatogenesis.

Didn't Attend. 36%

Relevance A 30% B 45% C 19% D 6% E 0

Interest A 33% B 39% C 27% D 2% E 0

Presentation A 28% B 34% C 26% D 11% E 0

12. Dr. Anderson — Placentation.

Didn't Attend. 48%

Relevance A 38% B 44% C 18% D 0 E 0

Interest A 36% B 44% C 18% D 3% E 0

Presentation A 31% B 41% C 26% D 3% E 0

13. Dr. Rieke — The Lymphocyte and Immune Mechanisms.

Didn't Attend. 31%

Relevance A 65% B 31% C 2% D 2% E 0

Interest A 56% B 38% C 6% D 0 E 0

Presentation A 44% B 48% C 6% D 0 E 2%

What did you get out of the lectures you attended?

57% A. Specific information.
30% B. Motivation to study.
64% C. Increased interest in the subject.
26% D. Research perspective.
8% E. Nothing.
F. Other. _____

Should a lecture series similar to this one be included in next years course?

81% ( ) Yes 19% ( ) No

Should a lecture series closely related in subject to the unit objectives be included in next years course?

51% ( ) Yes 49% ( ) No

Comments:

VI. OVERALL

Rate the importance to the overall effectiveness of future courses of each of the following:

1. Statements of specific objectives for each unit.

77% A 20% B 3% C D E

2. Rear-screen projectors and 2x2 slides.

56% A 31% B 13% C D E

3. Microscope slides.

53% A 35% B 9% C 4% D E

4. Written portions of the quizzes.

20% A 48% B 27% C 5% D E

5. Oral portions of the quizzes.

64% A 29% B 4% C 3% D E

6. Lectures.

5% A 31% B 40% C 15% D 8% E

7. Seminars.

5% A 5% B 14% C 34% D 41% E

8. Students setting their own paces for covering the material.

49% A 31% B 13% C 1% D 6% E

9. Midterm and final examinations.

10% A 10% B 26% C 16% D 38% E

Relative to other course formats to which you have been exposed, how would you rate the overall effectiveness of the one used in this course?

58% A 32% B 8% C 1% D 1% E

Comments: (Include any suggestions for the course that you have not already indicated on other pages).